Knowing When to Fertilize

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Should the field be fertilized? If so, how much of which fertilizers should be used? These questions are commonly faced by farmers each year.

The deliberations which finally lead to an answer vary greatly. The answers are often influenced by last year's use of fertilizer, the crop yield obtained, the price of fertilizer, soil test results, suggestions from other farmers, fertilizer dealers or county agents, and many other factors.

This fact sheet describes how answering the difficult question of how much fertilizer to use is basically as simple as answering the question, how much fuel or oil should I put in my tractor.

Mobile Nutrients = Fuel

The decision of whether or not to add fuel to a tractor depends essentially on two factors, 1) how much fuel is in the tank now and 2) how much work is planned for the tractor before there is a chance to add fuel again. The fuel guage conveniently shows how much fuel is in the tank so one simply has to estimate the amount of fuel it will take for the work planned and then add more if needed.

We are generally optimistic about the amount of work we expect to get done in a day (or afternoon) and so we make sure the fuel we have in the tractor is enough for the maximum amount of work we could do. We don't consider work-time lost for equipment adjustments, getting stuck, or being forced to quit early because of bad weather. With few exceptions, we will start with enough fuel in the tractor to have some left at the end of the day.

Because nitrogen is a mobile nutrient, crops will extract from the soil all the nitrogen they need in relation to their growth. When available nitrogen from the soil runs out, crop growth (dry matter production) essentially stops.

For dry land crop production, the yield limiting factor should be available soil moisture during the growing season.

The big question is how much nitrogen can the crop use during a particular growing season. For dryland farming, no one knows. It depends on rainfall during the season. So, unless we intend to limit yields by limiting nitrogen supply, we must estimate the nitrogen it will take (like fuel requirement) to produce the highest yield we think is possible. This ''yield goal'' may not be achieved more than one year out of five, but since we don't know what the weather will be like during the growing season, we have to fertilize mobile nutrients, like nitrogen, expecting the best. Usually this will result in some nitrogen left in the soil at the end of the growing season (like coming in from the field with some fuel in the tank).

If we don't know what the yield goal for a field should be, a starting point is to use the highest yield ever obtained for that field, and make sure it is above the field average.

The nitrogen needed for different yield goals of common crops can be found in Fact Sheet 2225. As an example, the table for wheat is shown below.

Yield Goal Bushels/Acre	Nitrogen Requirement Pounds N/Acre
15	30
20	40
30	60
40	80
50	100
60	125
70	155
80	185
100	240

Once the amount of nitrogen required has been decided, the only other information needed is how much nitrogen is available in the soil. Like checking the fuel gauge before going to the field, it is important to have the soil tested before fertilizing and planting. The soil test is like a fuel gauge. The amount of nitrogen found by the soil test can be subtracted from the total needed. The difference is what should be added as fertilizer nitrogen.

Immobile Nutrients = Oil

The decision of whether or not to add oil to a tractor is usually based on the oil level shown on the dipstick. The dipstick is checked whenever there is a chance the oil level is low, or routinely when fuel is added.

The dipstick is calibrated to show when the crankcase is ''full.'' When it is less than full, calibration marks indicate how much to add. The full mark is calibrated to the level of oil required to ensure there will be an adequate film of oil to lubricate the engine's moving parts.

Calibrated soil tests are the most reliable source of information for deciding whether or not to apply immobile nutrients like phosphorus.

Plants get immobile nutrients from a very thin layer of soil next to the root surface. Plants get all they need for whatever yield is possible when available phosphorus in the soil is high enough to provide an adequate supply next to root surfaces.

The OSU soil test for phosphorus is calibrated for Oklahoma crops and Oklahoma soils. The calibration was done by OSU agronomy researchers conducting hundreds of soil fertility experiments over many years all over the state. Calibration is a continuing effort with new crops and changing practices. The most recent calibrations are published in Fact Sheet 2225, the table for wheat is shown below.

Phosphorus Test Index	Percent Sufficiency	Phosphorus Deficiency (lbs. P_2O_5/acre)
0	25	80
10	45	60
20	80	40
40	90	20
65	100	0

So, the decision of whether or not to apply phophorus or potassium fertilizer can best be made by having the soil tested. If the phosphorus test value is above 65, the soil is "full" and there is no yield responses expected from fertilizer phosphate. If it is less than 65, the amount of yield as a percent of the possible yield can be calculated from the percent sufficiency value in the Table.

For example, if the phosphorus soil test value was 40, without adding phosphorus one could expect about 90% of the yield when phosphorus was not limiting. To correct the deficiency 20 pounds of P_2O_5 would have to be applied. The phosphorus would cost about $6.00 or two bushels of wheat. If the yield possibility were only 20 bushels per acre, then without fertilizer an 18 bushel yield would be expected (90% of 20) and 20 pounds of P_2O_5 would increase the yield by two bushels. This would be a break even point economically. Yield possibilities are usually high enough that whenever the soil test calibration indicates a need for 20 pounds or more phosphorus and 30 pounds or more potassium, the yield response more than pays for the fertilizer.

Soil testing then, is as much a key to fertilizer use decisions as the tractor fuel gauge and dipstick are to fuel and oil use decisions.

Extensions of the Comparison

1. What type of fertilizer should be used? Using a complete fertilizer on a field each year without having the soil tested is like putting fuel and oil into the tractor each day without ever checking the fuel gauge or dipstick. Oil would soon be overflowing the crankcase. Similarly, annual high rates of immobile nutrients results in building soil levels to above the "full" mark and it is possible to skip their addition some years.

2. The fuel gauge and dipstick are checked whenever there is uncertainty about the fuel and oil levels. Fields should likewise be soil tested whenever there is uncertainty about the level of available nutrients.

3. One does not add fuel and oil to all tractors based on the fuel gauge and dipstick readings of just one. By the same token, each field is different and needs to be soil tested individually.

4. If the work potential is high (large tractor), then the return on investing in an oil change and filter change is greatest when there is plenty of fuel to get a lot of work done. By the same token, correcting a large deficiency of an immobile nutrient (80 lbs. P_2O_5) is most economical if the amount of nitrogen supplied is adequate for a high yield.

5. Regardless of how much fuel is taken to the field, the maximum amount of work that can be done is limited by the size of the tractor. Soil productivities vary, and in a similar way, yield goals and the amount of nitrogen applied must be realistic in relation to yields that are possible.

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